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Short Communication

Under the lion's paw: lion farming in South Africa and the illegal international bone trade

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Abstract

The African lion *Panthera leo* is subject to numerous anthropogenic pressures across its natural range. In South Africa, although free ranging populations are increasing, the number of lions in captivity in private commercial facilities far outnumber those in the wild. South Africa's captive lion industry was reportedly created primarily to generate income and take pressure off wild populations through the supply of captive-bred lions for trophy hunting. However, the industry has become a highly contentious topic under ongoing international scrutiny and debate. Here, we present new information from direct interviews with workers at two closed-access lion facilities located in North West Province, on how some facilities continue to use legal activities, such as captive breeding and hunting, to facilitate their involvement in the illegal international felid bone trade. The sources also report other illegal and unethical activities including animal welfare violations, unsafe conditions for workers, potential shifts to the commercial exploitation of other felid species such as tigers *Panthera tigris* and incidents involving poaching of captive lions and tigers by non-affiliated actors. Sources described how some facilities use various tools and tactics, such as security cameras, patrols and messaging apps to avoid detection during inspections. If the South African Government is to be successful in meeting its publicly stated goal of ending the captive lion industry, a comprehensive well-managed plan to transition away from current practices is required. To aid enforcement, the industry should also be fully audited, with all facilities officially registered, a moratorium on the breeding of lions and plans put in place to prevent the stockpiling of lion bones.

Key words: African lion, big cat bone trade, captive lion breeding, *Panthera leo*, South Africa, wildlife trade, wildlife trafficking

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Introduction

The African lion *Panthera leo* is one of the world's most iconic large carnivores. The species is categorised as Vulnerable on the IUCN Red List with wild populations suspected to have declined by around 43% between 1993 and 2014 (around three lion generations) (Bauer et al. 2016) to an estimated 20,000 – 25,000 individuals (Nicholson et al. 2023). Widespread habitat loss, extensive prey base depletion and indiscriminate retaliatory or pre-emptive killing due to

human-wildlife conflict are amongst the main causes of population declines (Bauer et al. 2016). Regionally, lion populations are projected to reduce by a further 50% over the next two decades in West, Central and East Africa (Bauer et al. 2015). However, in a restricted, intensively managed geographical range in southern Africa (Botswana, Namibia, South Africa and Zimbabwe), several lion populations are stable or increasing (Nicholson et al. 2023).

In South Africa, the African lion is classified as Least Concern with an increasing wild population trend (Miller et al. 2016). Isolated and fragmented subpopulations of around 3,500 free-roaming lions occur in a few large protected areas, as well as many (~ 45) small (< 1000 km^2) fenced private or state-owned reserves (Miller et al. 2016). However, far more lions are currently kept in private captive facilities for commercial purposes in South Africa than exist in the wild (Chetty et al. 2024). South Africa's captive lion industry was reportedly created primarily to generate income and take pressure off wild populations through the supply of captive-bred lions for trophy hunting. Since 2008, the industry has grown exponentially, contributing an estimated R500 million (US$42 million) annually to the country's economy (Van Der Merwe et al. 2017). The current captive African lion population in South Africa is estimated at 7,838 individuals housed across 342 facilities that actively breed or keep felids and other large predators (Chetty et al. 2024). Since the 1990s, these lions have primarily been commercially captive-bred for the captive or "canned" hunting industry (where the skins and skulls of hunted lions are exported internationally as trophies for recreational hunters), along with interactive tourism and live exports (D'Cruze and Green 2023). The international supply of bones, body parts and derivatives to be used as ingredients in traditional Chinese medicine (TCM), is mostly a by-product of the captive hunting industry (Schroeder 2018; Williams and 't Sas-Rolfes 2019; Coals et al. 2020; D'Cruze and Green 2023).

African lions are the only *Panthera* species listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) since 1977, meaning that the international commercial trade in live specimens and derivatives is permitted with a relevant CITES export permit. Captive-bred lion bones and skeletons were legally exported from South Africa to Southeast Asia between 2008 and 2018 to be used in traditional medicinal and cultural preparations (Williams et al. 2017a). Annual exports of lion skeletons from South Africa rose from 60 in 2008 to a peak of more than 1700 in 2016 (Williams et al. 2017a). Export quotas were subsequently established for South African captive-bred lions, limiting the number of annual skeleton exports to 800 in 2017 and 2018 (Coals et al. 2019a). However, in 2019, a South African High Court decision determined that the export quotas were unlawful and constitutionally invalid due to insufficient consideration of the welfare of captive-bred lions (SAFLII 2019). Subsequently, no CITES export quotas for lion skeletons have been set (Williams et al. 2021), meaning that the export of lion bones originating from lion farms in South Africa is currently illegal.

South Africa's captive lion industry is a highly contentious topic under ongoing international scrutiny and scientific, ethical and political debate (Coals et al. 2019b, 2019a; Hiller and MacMillan 2021; Chetty et al. 2024). Some argue that breeding lions may help to reduce pressure on wild populations by saturating the market with affordable farmed lions for hunting and other products (e.g. Williams and 't Sas-Rolfes 2019). Criticism has, however, been directed on the

unethical practices, negative animal welfare, human health risks and the unregulated nature of the industry (Williams et al. 2015; NSPCA 2017; Fobar 2019; Green et al. 2020, 2022; de Waal et al. 2022; Heinrich et al. 2022). Increasingly, there are also concerns that the supply of captive-origin lion bones from breeding facilities could have unintended negative impacts on lion conservation by potentially driving an increase in poaching and trafficking of wild-sourced lions and perpetuating the international market for felid bones and other wildlife products (Williams et al. 2017a; Republic of South Africa 2021). In addition, some proponents of the industry have cited captive lion breeding as a potential source for re-introduction to help bolster wild lion populations (Abell et al. 2013). However, others argue that captive lions pose little value for species restoration because they are poorly equipped for survival in the wild, are often habituated to humans and their release could pose risks of human or livestock attacks or the introduction of novel pathogens which could be catastrophic to wild populations (Hunter et al. 2013).

In May 2021, South Africa's Department of Forestry, Fisheries and the Environment (DFFE) made a public announcement of its intention to immediately halt the "domestication and exploitation of lions and to ultimately close all captive lion facilities in South Africa" due to concerns that, amongst others, the industry was a threat to the country's reputation as a leader in conservation and ecotourism (Republic of South Africa 2021). Despite ongoing controversy and the Government's public statement of its intention to end the industry, commercial captive lion breeding and keeping has continued to operate legally in South Africa under a patchwork of complex provincial and national laws and regulations (Wilson 2019; Green et al. 2021; Chetty et al. 2024). Inconsistencies, regulatory complexity, together with a lack of national databases for permits issued related to the breeding, keeping, transport, hunting, killing and trade of lions, has resulted in legal loopholes and enforcement challenges, creating opportunity for harmful and fraudulent practices to exist (de Waal et al. 2022). In particular, a lack of enforcement on the illegal export of lion bones has created a legal grey area leading to confusion and non-compliance. Consequently, there are concerns that South Africa's legal captive lion breeding and hunting industry is a detrimental conduit for illegal wildlife trade activities (de Waal et al. 2022).

Around a third of South Africa's 342 captive lion facilities are open to the public who pay to see and have direct contact with lions through activities such as "cub petting" and "walking with lions" experiences (de Waal et al. 2022; Wilson and Phillips 2023). The other two thirds are situated in remote locations and operate "off grid" and closed to the public. These facilities primarily function as breeding operations to supply lions for the legal captive hunting industry. However, because they are poorly monitored [in part because the provincial nature conservation authorities lack capacity to adequately monitor and enforce legislation (de Waal et al. 2022; Chetty et al. 2024)], little is currently known about how these facilities operate and the practices taking place related to the hunting, slaughter, preparation and trade of hunted animals.

Here, we present new information from direct interviews with workers at two closed-access lion facilities located in the North West Province, on how some facilities in South Africa use legal activities, such as captive breeding and hunting, to practise illegal and unethical activities including international felid bone trade.

Methods

The rural North West Province in South Africa (Fig. 1) is a hotspot for the country's commercial captive lion breeding industry (Van Der Merwe et al. 2017). Around 90 facilities located in North West Province hold around a third of South Africa's total captive large felid population (de Waal et al. 2022) and approximately 80% of lion hunting in South Africa is thought to occur in the North West and Free State Provinces (Van Der Merwe et al. 2017). Lion facilities in North West Province are predominantly orientated towards hunting, but some also breed, keep and sell live lions, typically also for the hunting industry (Williams and 't Sas-Rolfes 2019).

Face-to-face interviews with anonymous sources from two closed-access lion facilities located in North West were conducted by external field researchers between August and October 2022. Transcripts from the interviews were subsequently provided to World Animal Protection in late 2022. At the time of the interviews, one of the facilities reportedly kept lions and the other kept both lions and tigers *Panthera tigris* for captive hunting and the felid bone trade. Hunting of the animals occurred in purpose-built enclosures on their premises. One of the facilities did not breed lions, but purchased them from local breeding facilities for each hunt. The other facility bred both lions and tigers and hunts were facilitated for a "largely Asian client base". The anonymous sources were employed at the facilities to transport and collect lions and tigers for trophy hunting and to skin and prepare the bones of hunted animals.

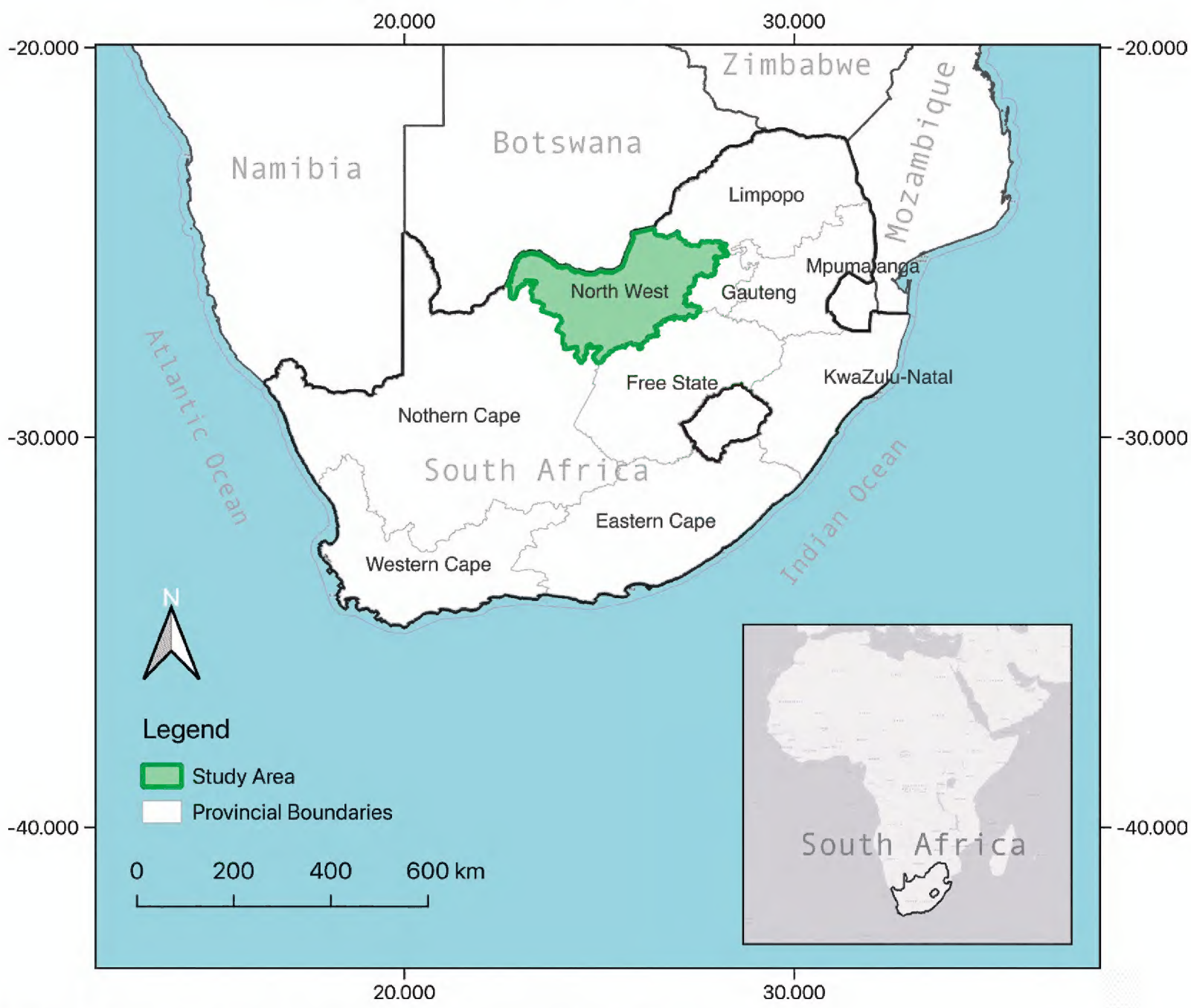

Figure 1. Map of the study area in North West Province, South Africa.

A set of predetermined questions that included open-ended, closed and multiple-choice were used during the interviews to gather insights into the different stages of production of lion bones for export. Key questions related to the welfare conditions of lions in captivity, the processes involved in the lion trade, such as how the animals were transported and slaughtered, how the products (e.g. skin and bones) from trophy hunts were processed and which stakeholders were involved in the different trade chain stages. In accordance with the British Sociological Association Statement of Ethical Practice (BSA 2017), informed consent was obtained verbally from the anonymous sources prior to the interviews and they were made aware of their rights to voluntarily participate or to decline. In order not to compromise the privacy and safety of the sources, no personal identifiable information was recorded and the names and/or the precise locations of the facilities are not reported.

Results

The export of lion bones originating from captive lion facilities is currently illegal in South Africa, following the High Court declaration in 2019 in which the lion bone export quota was declared unconstitutional and no CITES export quotas for lion skeletons have subsequently been set (Williams et al. 2021). Despite this, the anonymous sources reported that, after a captive trophy hunt, the skin, paws and skull of the lions were kept as trophies by the hunters, whereas the lion's bones were cleaned and prepared for "Asian bone buyers". The stages of production of lion bones for illegal export are presented in Table 1, along with an outline of the relevant national and provincial level legislation pertaining to each stage of production and the legal irregularities noted in this study.

In some cases, entire lion carcasses were reportedly left intact and were packed into cardboard boxes ready for shipment and for "Asian bone buyers to collect". This was reportedly done to certify authenticity (that it was a lion carcass) and ensure tracking devices had not been inserted into the bones. One source stated that all tigers and lions killed on the premises in the past year were used to supply the bones and parts trade. Other actors involved reportedly assisted in obtaining permits and licences for lion hunting and bone export (Note - It is currently not possible to obtain a CITES export permit for lion/tiger bone exports from South Africa. If provinces issue a CITES permit, they are in contravention of the zero lion bones quota set by the Minister. It is unclear what permit the source was referring to in this case study.). The sources described how the facilities use various tools and tactics, such as security cameras, patrols and messaging apps to avoid detection during inspections.

Sources also stated that some farm owners appeared to be shifting operations from lions to tigers and ligers, lion-tiger hybrids, which could be in response to South Africa's recent announcement of its decision to end lion farming. One source reported that tigers and lions from various age classes were transported to the facility from other breeding facilities several times a year. Nearly twice as many tigers compared to lions were reportedly kept at the facility.

Furthermore, according to the sources, several lion facilities in the region have been experiencing pressure from organised poaching networks suspected of targeting lions and tigers for illicit wildlife trade. This has allegedly happened more frequently over the past four years, resulting in the death of more than sixty animals

Table 1. The stages of production of lion and tiger bones for illegal export from a case study of two closed-access commercial captive lion facilities in North West Province, the relevant national and provincial level legislation pertaining to each stage of production and legal irregularities noted in this study.

Stages	Steps	Location	Actor(s)	Product status	Example of participant's statement	All relevant legislation and permits required[1]	Legal irregularities specifically suggested in this study in relation to North West Province
Captive bred	Lion/tiger cub legally born and raised at a registered lion breeding facility	Lion breeding facility in North West Province	Facility owner; Facility labourer(s); Off-site veterinarian	Live lion/ tiger	*"One to four lions and tigers are kept per enclosure. Both lion and tiger cubs stay with their mothers in the enclosure. Cubs remain with their mother for up to six months".; "Cubs are not tagged, chipped or marked in any way for record keeping purposes".; "The enclosures are not cleaned regularly. Lions are fed once a month - on any meat available – dead beef cattle, chicken and sometimes wildlife harvested for the specific reason. Portable borehole water is available at the enclosures. No enrichment is provided. Nobody is taking care of the lions full-time".; "Veterinary care is minimal. The owners use a veterinarian from a neighbouring town to perform clinical and mainly dart work on the lion".; "The perimeter fence and gates are run down and wide gaps exist between run-over fence material. As a result, a vehicle can easily drive through openings in the perimeter fence".*	National Environmental Management Biodiversity Act, 2004 (Act 10 of 2004): Threatened or Protected Species Regulations (2007) (TOPS). TOPS captivity permit required for lions and tigers. North West minimum enclosure requirements; Min. 1,500 m^2 up to four animals, plus 150 m^2 or 400 m^2 for each additional animal; Max. of 10 individuals per enclosure. Animals Protection Act (1962); North West Wildlife Fencing Policy (2008); Amendment to the North West Wildlife Fencing Policy (2009).	Lack of marking for cubs is non-compliant with TOPS regulations; Dirty enclosures and an inadequate feeding regime for the animals is potentially non-compliant with the APA; Fencing is potentially non-compliant with the North West Wildlife Fencing Policy (2008) and/or Amendment to the North West Wildlife Fencing Policy (2009).[2]
Procure	Adult lion/tiger legally captive-bred at a registered lion breeding facility is selected for the hunt; OR lion/tiger is purchased from breeding facility by facility owner or hunter(s)	Captive lion facility; Lion breeding facilities in North West or other provinces (e.g. Free State and Limpopo)	Facility owner; Supplier(s); Hunter(s)	Live lion/ tiger	*"Lions and tigers are transported from other facilities as well as captive bred on the premises".; "The lions are brought from within the region or other provinces".; "Lions are purchased as required for each hunt or at least shortly prior to each hunt. There are multiple suppliers".; "During the hunting season, there are more lions arriving".; "Lions are collected from numerous different lion breeding facilities and deliveries of lions also take place".; "The lion is pre-selected by the hunter".*	TOPS permits required for both lions and tigers [captivity permit, transport permit (both within North West Province and between provinces - import and export), hunting permit]; TOPS permit required for lion hunt. Within the North West Province, only permission of the landowner is required for a tiger hunt.	No suggestion of legal irregularities related to procurement specifically referenced in this study.
Broker	Contact person who ordered the hunt; Contact Asian bone buyer/collector; Contact other actor to obtain permit for lion/tiger hunt	Captive lion facility	Facility owner; Asian bone buyer/collector; Hunter(s); Middleman (to obtain hunting permit)	Live lion/ tiger	*"[lions are bred at the facility] for lion trophy hunting and the bone trade".; "All lions and tigers on the property last year were killed for their bones and parts".; "All lions hunted are slaughtered and some of the clients want their complete skeletons, whilst other clients do not insist on the skeletons and, in those cases, the bones are sold to a bone buyer".; "Other actors assist in obtaining permits and licences for lion hunting and bone export".*	TOPS transport permit required to move the live animal or carcass within the province and/or import/export permits required between provinces; TOPS permit required for lion hunt. Within the North West Province, only permission of the landowner is required for a tiger hunt.; TOPS permit required to be in possession of a lion carcass. For lions (and possibly for tigers), records need to be kept by facility owner on the origin of the carcass, such as hunting permit and professional hunter registers or veterinarian report in case of a natural death. If bones obtained through euthanasia rather than hunting, in North West, a TOPS permit is required and no euthanasia is allowed unless for medical reasons with veterinarian approval. CITES export permit required for bone export.	No legal CITES lion bone export quota since 2019. No legal CITES tiger bone export quota since 1975. Lion/ tiger bone export is illegal (although domestic trade in lion/tiger bones is currently legal in South Africa).

Stages	Steps	Location	Actor(s)	Product status	Example of participant's statement	All relevant legislation and permits required[1]	Legal irregularities specifically suggested in this study in relation to North West Province
Transport	Lion/tiger is "darted with a tranquilliser" and loaded in a crate on a utility vehicle/ pickup truck; Lion/ tiger transported via a lorry from breeding facility to hunting facility by supplier, facility owner or hunter(s); OR lion/ tiger transported from breeding enclosure to hunting enclosure (if on same site); Facility labourer assists with loading and offloading of lion/ tiger	Road network within North West or other provinces (e.g. Free State or Limpopo); OR within the captive lion facility	Facility labourer(s); Facility owner; Supplier; Hunter(s); Off-site veterinarian	Live lion/ tiger	*"Lions are darted and tranquillised by chemicals and loaded in the sleeping position in crates and utility vehicles".*; *"A local veterinarian illegally supplies sedation drugs to non-certified personnel for a fee to aid canned hunting".*	Currently no national norms and standards or permits required for darting a lion/tiger and the type of tranquilliser used for transporting a lion/tiger, but this should be administered by a veterinarian or a person authorised by a veterinarian and in possession of a valid permit[3]. South African National Standards (SANS) codes relating to the transportation of wild animals, such as "the vehicles for the transportation of wild carnivores by road to holding pens and other facilities (SANS 1884-3:2008). In North West, lions can be bred and hunted on the same facility, but regulations vary by province.[4]	Non-certified person administering sedatives to captive wild animals is non-compliant with SANS 1884-3:2008.
Slaughter	Lion/tiger shot by hunter(s) in hunting enclosure	Purpose-built hunting enclosure on captive lion facility	Hunter(s); Facility labourer(s) / trackers	Whole carcass	*"All lions* [at the facility] *are hunted".*; *"For most cases it* [tracking the released lion] *would not take more than four hours".*; *"About an hour after their release, the lion has been hunted".*; *"Three lions were shot by a hunter from the back of a vehicle within an hour of release and while still partially sedated".*; *"No tracking of lions and tigers is done as the animals are killed in a* [area less than 1 ha] *hunting enclosure".*;	TOPS permit required for lion hunt. Within North West, only permission of the landowner is required for a tiger hunt. North West provincial regulations stipulate a required minimum captive hunting area of 1,000 ha. North West provincial regulations stipulate a minimum time of 96 hrs between the release of a captive-bred lion into a hunting camp and the hunt taking place. Hunting of sedated lions/tigers is not allowed under the TOPS Regulations. Note - specific regulations pertaining to captive hunting vary by province[5].	Hunts conducted in an enclosure measuring < 1 ha is non-compliant with the North West provincial regulations pertaining to the captive lion breeding industry. Lions transported from breeding to hunting facilities drugged and hunted within an hour of release is non-compliant with the North West provincial regulations pertaining to the captive lion breeding industry. Hunting sedated lions is non-compliant with TOPS Regulations.
Transport	Hunted lion/tiger transported via a pickup truck/hunting vehicle from hunting area to slaughter/ processing area on captive lion facility	Processing area on captive lion facility ("slaughterhouse or "skinning shed")	Facility labourer(s)	Whole carcass	"[lions come] *from the hunting enclosure on a hunting vehicle SUV / pickup truck".*;	TOPS permit required to be in possession of a lion carcass. For lions (and possibly for tigers), records need to be kept by facility owner on the origin of the carcass, such as hunting permit and professional hunter registers, or veterinarian report in case of a natural death. TOPS transport permit required to move the lion/tiger carcass within the province and/or import/export permits required between provinces.	No suggestion of legal irregularities related to the transport of lion/tiger carcasses specifically referenced in this study.

Stages	Steps	Location	Actor(s)	Product status	Example of participant's statement	All relevant legislation and permits required[1]	Legal irregularities specifically suggested in this study in relation to North West Province
Process	Facility labourer(s) skins hunted lion/ tiger as soon as possible after the hunt. All meat and tendons are removed from the skeleton. The skin, paws, and skull are processed and cleaned by the facility labourer(s). These parts are then sent to a taxidermist to be processed into trophies which are kept by the hunter. The hunted lion/tiger bones / skeleton are cleaned, salted and prepared by the facility labourer(s) for illegal wildlife traffickers	Processing area on captive lion facility ("slaughterhouse or "skinning shed")	Facility labourer(s)	Bones/ skeleton without skull (cleaned); Whole carcass (cleaned)	"[bone preparation] *happens as the animals are hunted throughout the day*".; "*Lion is gutted, skinned and all meat removed from the skeleton with a knife and left to dry. After a few days, the skeleton is submerged in coarse salt to preserve it'.*"; "*Due to the heat, all animals hunted are to be skinned as soon as possible*".; "*Hunted animals are skinned for the purpose of preserving the skin for the tannery or taxidermy process involved in building the trophy*".; "*Skins are salted and left to dry in a shaded place with no direct sunlight. Normally a skinning shed*".; "*Skins, paws, skull are sought after trophies by the hunter. Bones and skeleton are sold to Asian buyers*".; "*Once dried of all meat and washed, the bones will be stored in a secure barn*".; "*Records of the bones processed are not kept*".	TOPS permit required to be in possession of a lion carcass. For lions (and possibly for tigers), records need to be kept by facility owner on the origin of the carcass, such as hunting permit and professional hunter registers or veterinarian report in case of a natural death. No national norms and standards on processing of lion/tiger carcasses. CITES export permit required for bone export. North West Province stipulates that records for lion bone/carcass need to be kept on the origin of carcass, such as hunting permit and professional hunter registers or veterinary report in case of natural deaths.	No legal CITES lion bone export quota since 2019. No legal CITES tiger bone export quota since 1975. Lion/ tiger bone export is illegal (although domestic trade in lion/tiger bones is currently legal in South Africa).; Lack of recording keeping of the bones processed is non-compliant with North West permit regulations.
Package	Cleaned lion/tiger bones / skeleton, OR whole intact carcass is carefully packaged into a cardboard box by facility labourer(s) and prepared ready for shipment; OR cleaned lion/tiger bones / skeleton are packed with the skin (when requested by the client)	Captive lion facility	Facility labourer(s)	Cleaned whole carcass (packaged); OR cleaned bones/ skeleton (packaged)	"*Bones are carefully packed in cardboard boxes and in other cases, packed with the skins when the clients insisted that the bones be shipped/exported with the trophies*".; "*Bones are not tagged or market for record keeping – everything goes to the buyer unmarked*".	CITES export permit required for bone export.	No legal CITES lion bone export quota since 2019. No legal CITES tiger bone export quota since 1975. Lion/ tiger bone export is illegal (although domestic trade in lion/tiger bones is currently legal in South Africa). Pre-2019, the DFFE stipulated that all skeletons that qualify for the quota must be tagged by a provincial Environmental Management Inspector. Not marking or tagging of bones would therefore be non-compliant with TOPS regulations.
Inspect	Prepared bones are "inspected" by facility owner	Captive lion facility	Facility owner	Cleaned whole carcass (packaged); OR cleaned bones/ skeleton (packaged)	"*All bones are "inspected" by the employer*".	No legislation available	No suggestion of legal irregularities related to the inspection of prepared bones specifically referenced in this study.

Stages	Steps	Location	Actor(s)	Product status	Example of participant's statement	All relevant legislation and permits required[1]	Legal irregularities specifically suggested in this study in relation to North West Province
Sell	Lion/tiger bones/ skeleton OR whole intact carcass are sold to Asian bone buyer/collector for export; Permit obtained for bone export	Captive lion facility	Facility owner; Asian bone buyer/collector; Middleman (obtains export permit); Exporter	Cleaned whole carcass (packaged); OR cleaned bones/ skeleton (packaged)	*"The facility owners handle the* [processed] *bones".*; *"Other actors assist in obtaining permits and licences for lion hunting and bone export".*	CITES export permit required for bone export. If bones are obtained through euthanasia rather than hunting, in North West, a TOPS permit is required and euthanasia is not allowed unless for medical reasons with veterinarian approval.	No legal CITES lion bone export quota since 2019. No legal CITES tiger bone export quota since 1975. Lion/ tiger bone export is illegal (although domestic trade in lion/tiger bones is currently legal in South Africa). It is currently not possible to obtain a CITES export permit for lion/tiger bone exports from South Africa. If provinces issue a CITES permit, they are in contravention of the zero lion bones quota set by the Minister. It is unclear what permit the source was referring to in this case study.
Collect	Asian bone buyer collects prepared shipment from facility owner	Captive lion facility	Facility owner; Asian bone buyer/collector	Cleaned whole carcass (packaged); OR cleaned bones/ skeleton (packaged)	*"Bones are collected by Asian individuals".*; "[buyers are at the facility] *whenever bones and other products are available".*; *"A person of Asian descent visits specifically to collect bones".*; *"All bones are collected after every Safari".*	CITES export permit required for bone export. TOPS transport permit required for transporting bones.	No legal CITES lion bone export quota since 2019. No legal CITES tiger bone export quota since 1975. Lion/ tiger bone export is illegal (although domestic trade in lion/tiger bones is currently legal in South Africa).
Export	Shipment is exported	International airport (South Africa)	Exporter	Cleaned whole carcass (packaged); OR cleaned bones/ skeleton (packaged)	No specific reference was made by the participants in relation to international export (only "export"). However, recent lion bone seizures have been made at airports in South Africa and reported in the media.[6]	CITES export permit required for bone export.	No legal CITES lion bone export quota since 2019. No legal CITES tiger bone export quota since 1975. Lion/ tiger bone export is illegal (although domestic trade in lion/tiger bones is currently legal in South Africa).

[1]The following legislation pertains to the industry and its activities overall: NW primary nature conservation and biodiversity ordinances: North West / Transvaal Nature Conservation Ordinance, 12 of 1983; Cape Nature & Environmental Conservation Ordinance, 19 of 1974; Bophuthatswana Nature Conservation Act, 3 of 1973. Policies pertaining captive lions: Cape Problem Animal Control Ordinance, 26 of 1957. [2]See Chetty et al. (2024) Table 6.3 for a summary of the NW fencing policy for captive lions. [3]Protocols have been developed by the MTT (see Chetty et al. 2024). [4]See Chetty et al. (2024) for an outline of provincial differences in regulations. [5]See Chetty et al. (2024) Tables 6.1-6.5 for an outline of provincial differences in regulations pertaining to captive lion hunting. [6] https://www.news24.com/news24/southafrica/news/fur-crying-out-loud-man-en-route-to-vietnam-with-lion-bones-in-luggage-arrested-at-or-tambo-airport-20230624

in five facilities by non-affiliated and/or criminal actors. The most common method of inducing death is reported to be through the use of poison-laced chicken and often only the heads and paws of the animals are harvested by the poachers.

Testimony also indicates that illegal hunting practices have taken place at the facilities (Table 1). First, that hunts have been conducted in an enclosure measuring < 1 ha, which would be illegal due to non-compliance with provincial regulations which stipulate a required minimum area of 1,000 ha (Chetty et al. 2024). Second, that some lions transported from breeding to hunting facilities were drugged and hunted within an hour of release, which would be in violation of the provincial legal minimum release period of 96 hours (Chetty et al. 2024). According to one source, "*a local veterinarian illegally supplies sedation drugs to non-certified personnel for a fee to aid canned hunting*". An incident was also recalled when three lions were shot by a hunter from the back of a vehicle within an hour of release and while still partially sedated. The hunting of sedated lions is illegal in South Africa and would contravene the national Threatened or Protected Species (TOPS) Regulations of 2007 (Table 1).

The sources also reported unethical animal welfare practices taking place at the facilities. Specifically, they detailed malnutrition, lack of clean water, dirty enclosures with inadequate fencing, minimal veterinary treatment, lack of enrichment or shelter and other poor husbandry practices. One source described how lions kept on the premises were being deliberately starved throughout the low-hunting season, reportedly to save costs.

The transcripts also provide information on the unsafe working conditions for labourers at the facilities. The labourers, who reportedly earn minimum wage, have limited subsistence allowances, and do not wear protective gear when slaughtering and preparing the bodies of hunted animals. One source also stated that they may be threatened with consequences to themselves and their families if they speak out about the mismanagement of lions and their involvement in the illegal supply of lion bones for international trade.

Discussion

Our findings corroborate pre-existing concerns that South Africa's captive lion industry is inadequately protected from criminal activity and non-compliance with regulations (Williams et al. 2015; Sharife 2022). We provide new insights into the procedures and mechanics of how some lion facilities use legal activities, such as commercial captive breeding and hunting, to practise illegal and unethical activities including international felid bone trade (Table 1, Plate 1). Our case study highlights how the complexity of the regulatory system pertaining to South Africa's captive lion industry, which currently operates under a patchwork of provincial and national laws and regulations related to the breeding, keeping, transport, hunting, killing and trade of lions (Wilson 2019; Green et al. 2021), can result in legal loopholes and enforcement challenges, creating opportunity for harmful and fraudulent practices to exist (Table 1). Corruption amongst wildlife enforcement officials and a lack of resources and proper record-keeping also make it difficult for authorities to manage the industry and ensure facilities comply with the law (de Waal et al. 2022; Heinrich et al. 2022).

Our finding that there has reportedly been an increase in the number of tigers and lion-tiger hybrids being kept and bred at some lion facilities in South Africa is

Plate 1. Left: Prepared lion skeleton (credit: Lord Ashcroft KCMG PC); Right: Lion at a commercial breeding facility in South Africa (credit: Roberto Vieto/World Animal Protection).

also a source for concern. The apparent shift in focus from lions to tigers could be a potential mechanism to supplement lion bone trade demand in response to the Government's announcement of its decision to close the captive lion breeding industry (Republic of South Africa 2021). A large proportion of the tigers bred in South Africa are exported as live animals and body parts to China, Vietnam and Thailand, which are renowned hotspots for demand in tiger body parts and the illegal tiger trade (Williams et al. 2015). Both tiger and lion parts (including bones, teeth and claws) are known to be traded in Southeast Asia and China (Coals et al. 2020). Lion bone is thought to be used as a substitute in tiger bone wine in Traditional Chinese Medicine (TCM) products (Coals et al. 2020; Moorhouse et al. 2021), but recent evidence also suggests an emerging demand for lion derivative products in Vietnam and China (EMS and BAT 2018; Outhwaite 2018). Given the difficulty in distinguishing lion bones from tigers (Williams et al. 2015; Dalton et al. 2020), there is a particular risk posed by having other large felids on farms in South Africa when their bones could be used as substitutes for lion bones and this situation could have detrimental compounding effects on already vulnerable populations of species, such as tiger, across their range (Nicholson et al. 2023).

Our interviews with anonymous sources also suggest that some lion facilities have been experiencing pressure from organised poaching networks suspected of targeting captive lions and tigers for illegal wildlife trade and that, often, only the heads and paws of poisoned animals are harvested by the poachers. This finding raises a particular concern that warrants further investigation and verification. Other similar anecdotal reports have been documented of the suspected poaching in South Africa of lions to supply the Asian market (Miller et al. 2014) and a rise in incidents of lion poisonings on private property in South Africa over the past decade (Williams et al. 2017b). Although the direct link between trade in farmed lion parts and poaching of wild lions is currently largely unknown (Everatt et al. 2019; Coals et al. 2020; Macdonald et al. 2021), across range states, there has been growing concern over the impact of illegal trade in lions, as well as increasing numbers of targeted lion poaching incidences, with the removal of body parts, such as skulls,

teeth and claws from lions in Mozambique, Namibia and Tanzania (Everatt et al. 2019; Coals et al. 2022; Arias et al. 2024). These incidents are thought to be linked to domestic, regional and international trade in lion body parts from illegal sources due to their proliferating value (Outhwaite 2018; Bodasing 2022; Miller et al. 2023; Arias et al. 2024). The targeted poaching of lions for their body parts was also recognised as an emerging threat to lion conservation in the most recent IUCN species assessment (Nicholson et al. 2023). Although the impact of lion farming on wild populations in South Africa is considered to be minimal (Scientific Authority of South Africa 2018), the role of farms in stimulating illegal poaching from wild populations is currently unclear (The Supreme Court of South Africa 2010; Hunter et al. 2013; Bauer et al. 2018) and warrants further investigation.

The South African government is currently on a trajectory to close the captive lion breeding industry through a consultative process initiated in 2018. A High-Level Panel of experts were appointed in 2020 to review the industry's policies, practices and management, which led them to recommend termination of the industry and all its associated commercial activities. These recommendations were subsequently approved by Cabinet, based on conclusions that, amongst others, captive lion breeding does not contribute to the conservation of wild lions, shows inherent animal welfare and public health concerns, poses concerns over the safety of workers and visiting public and presents a threat to South Africa's reputation as a responsible ecotourism destination, with associated political and economic risks (Department of Forestry, Fisheries and the Environment 2023). These concerns were corroborated in the Government's Policy Position on Conservation and Sustainable use of South Africa's Biodiversity (Department of Forestry, Fisheries and the Environment 2024) and in a report published earlier this year by the Ministerial Task Team (MTT) that was initiated to identify voluntary exit options from the captive lion breeding industry (Chetty et al. 2024).

If the South African Government is to be successful in meeting its publicly stated goal of ending the captive lion industry, a comprehensive, well-managed plan will be required to ensure a responsible transition away from current practices and recommendations have been provided in the recent MTT report (Chetty et al. 2024). To help enforcement agencies manage and ensure facilities comply with the law during an effective phase-out, the industry should be fully audited, with all facilities officially registered, a moratorium on the breeding of lions issued and suitable plans put in place to prevent the stockpiling of lion bones (Chetty et al. 2024). This decision should be mandatory and made in lock step across provinces through the streamlining of all provincial and national-level legislation pertaining to the industry. The decision should also be extended to other felid species that could potentially be used as substitutes for the illegal international bone trade (D'Cruze and Elwin 2023). For example, an estimated 492 tigers were kept in registered private facilities in South Africa in 2022 (de Waal et al. 2022) and our study highlights reports of increasing numbers of tigers held on lion farms in recent years, which is corroborated by the 626 tigers reported in 2023 (Chetty et al. 2024). More broadly, we reiterate the importance of monitoring and regulation to reduce the risk of criminal and non-compliant activity related to the commercial captive lion industry and associated illegal international bone trade, particularly during the transition to terminate the industry. To support these efforts, all information provided here on illegal wildlife trade activities has been reported to the South African Government.

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Additional information

Conflict of interest

None. All authors are employed by the animal welfare organisation World Animal Protection (NDC holds the position of Head of Animal Welfare and Research; AE is Wildlife Research Manager; EA is Wildlife Investigations Advisor). Our results pertaining to this study were in no way influenced by our own personal views on animal welfare.

Ethical statement

In accordance with the British Sociological Association Statement of Ethical Practice (BSA 2017), informed consent was obtained verbally from the anonymous sources prior to the interviews, and they were made aware of their rights to voluntarily participate or to decline. In order not to compromise the privacy and safety of the sources, no personal identifiable information was recorded, and the names of and/or the precise locations of the facilities are not reported.

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Author contributions

AE: Formal analysis, Writing – Original draft, Writing – Review and Editing; EA: Formal analysis, Writing – Review and Editing; NDC: Formal analysis, Writing – Review and Editing.

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Data availability

The data that support the findings of this study are available on request from the corresponding author, NDC. The data are not publicly available due to their containing information that could compromise the privacy and safety of research participants.

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